

Amendments to the Drawings:

The attached replacement sheets of drawings for Figures 1B, 1C, 2, and 4 adhere to the correct format and replace the original sheets that were filed with the application. No amendments have been made to the drawings.

Attachments following last page of this Amendment:

Replacement Sheets (4 pages)

REMARKS

Claims 1-3, 5-27, 29-51, 53-75, and 77-104 are currently pending in the Application. Claims 1, 25, 49, and 73 are independent. Claims 1, 5, 16, 20, 23, 25, 29, 40, 44, 47, 49, 53, 64, 68, 71, 73-96, 99, and 103-104 have been amended. Claims 4, 28, 52, and 76 have been cancelled. No new matter has been added. Applicant respectfully requests reconsideration in view of the foregoing amendments and the following remarks.

I. Objections to the Drawings

The Examiner objected to the format of Figures 1B, 1C, 2, and 4. Applicant has attached corrected drawing sheets corresponding to each of these figures. Applicant believes that the drawings are in compliance with 37 C.F.R. 1.83 as currently presented, and respectfully requests withdrawal of the objection.

II. Objections to the Specification

The Examiner objected to the Specification, requesting that Applicant delete the footer text on the bottom of claim pages 23-44 in order to avoid vague claimed limitations. Applicant has attached a substitute specification in which this footer text has been omitted. Applicant respectfully requests withdrawal of the objection.

III. Claim Objections

The Examiner objected to the numbering of claims 95-97, as no claim 94 was included in the listing of the claims originally filed. The Examiner stated that claims 95-97 should be renumbered as claims 94-96. For consistency, Applicant has renumbered claims 95-105 as claims 94-104. Accordingly, Applicant respectfully requests withdrawal of the objection.

The Examiner objected to claims 16, 20, 23, 40, 44, 47, 64, 68, 71, 88, 92, and 96 because the parameter H was not described. Applicant has amended the claims to correct for these informalities. Support for this amendment is found at least in the Specification at, for example, page 3, para. [0007]. Applicant respectfully requests withdrawal of the objection.

IV. Claim Rejections under 35 U.S.C. § 101

The Examiner rejected claim 73, stating that the claimed invention is allegedly directed to non-statutory subject matter. While Applicant believes that claim 73 was allowable as written,

Applicant has amended the claim to address the Examiner's concerns in order to expedite prosecution. Applicant respectfully requests withdrawal of the rejection in view of this amendment.

V. Claim Rejections under 35 U.S.C. § 112

The Examiner rejected claim 25 under 35 U.S.C. § 112, ¶ 2, stating that "it does not make sense. . . to state that a training sequence received in a preamble since the preamble is a part of packet transmitted and received via a transmission medium." Applicant respectfully points the Examiner to the discussion in the Specification at, for example, pages 2-3 and 6-9, which explains that training sequences are contained within the preamble of a wireless communication signal. Specifically, to perform frequency synchronization, a transmitter "transmits two repeated, identical, time domain training sequences in two preambles" to a receiver. Id.; *see also* page 2, para. [0004]. Applicant respectfully requests withdrawal of the rejection of claim 25 under 35 U.S.C. § 112, ¶ 2.

The Examiner also rejected claim 49 under 35 U.S.C. § 112, ¶ 2, stating that "since no function is specified by the word(s) preceding "means," it is impossible to determine the equivalents of the element as required by 35 U.S.C. § 112, sixth paragraph." Applicant respectfully submits that claim 25 does recite the specific functions performed by the claimed means elements. For example, the first limitation of claim 49 recites means for receiving preambles and data symbols. The second limitation recites means for performing a Fourier transform of a training sequence received in a preamble. Each limitation of claim 49 similarly recites a specific function, and the specification adequately describes each such function. Therefore, Applicant respectfully asserts that claim 49 fully complies with 35 U.S.C. § 112, ¶ 6, which provides that an element "may be expressed as a means or step for performing a specified function, without the recital of structure, material, or acts in support thereof." Applicant respectfully requests withdrawal of the rejection of claim 49 under 35 U.S.C. § 112, ¶ 2 and of all claims depending from claim 49.¹

¹ The Examiner relies on *Ex parte Klumb*, 159 U.S.P.Q. 694 (Bd. Pat. App. 1967) for his rejection of claim 49. This case is inapposite. In *Klumb*, the Board decided that the standalone claim terms "plate means" and "wing means" did not specify any particular function and therefore did not comply with the statutory requirements for means-plus-

VI. Claim Rejections under 35 U.S.C. § 103

A. The Examiner rejected claims 1-18, 25-42, 49-90, 73, 92, 94, and 96 for allegedly being unpatentable over U.S. Patent No. 7,085,223 B2 ("Izumi") in view of U.S. Patent No. 7,099,413 B2 ("Chuang"). Applicant has amended independent claims 1, 25, 49, and 73. Support for the amendments is found at least in the Specification at, for example, page 3, para. [0007]; page 4, paras. [0009]-[0010]; and page 9, para. [0031]. Applicant respectfully requests withdrawal of the rejections under 35 U.S.C. § 103 in view of the foregoing amendments and the following remarks.

A. Claim 1 and its dependent claims

Claim 1 as amended is directed to a method that includes receiving a preamble across a channel, the preamble including two or more training sequences, performing a Fourier transform of the training sequences, and deriving initial channel estimates in the frequency domain with the received preamble and a stored preamble. The method further includes receiving data symbols across the channel, demodulating and decoding the data symbols, and updating the channel estimate using the demodulated and decoded data symbols.

The Examiner suggests that Izumi shows Applicant's claimed method. The Examiner acknowledges that Izumi fails to disclose Applicant's claimed step of updating a channel estimate using the demodulated and decoded data symbols, but suggests that Chuang shows this step. Applicant respectfully disagrees. Applicant respectfully submits that Izumi fails to teach or suggest, at least, receiving a preamble, the preamble including two or more training sequences. Applicant further submits that the Examiner has failed to establish a proper motivation to combine the teachings of Izumi and Chuang.

Izumi shows a communication device for transmitting and receiving orthogonal frequency division multiplex ("OFDM") signals. Izumi's device includes a plurality of antenna elements, each of which receives a transmitted OFDM signal composed of multiple subcarrier signals. (Col. 4, lines 40-47; col. 5, lines 11-13). After the antenna elements receive the OFDM signal, Izumi's "channel estimation means" determines "attenuation values" for each subcarrier

function claims. 159 U.S.P.Q. at 695. In contrast, Applicant's claim 49 identifies the specific functions performed by each means element, fulfilling the requirements of 35 U.S.C. § 112, ¶ 6.

signal at every antenna element. (Col. 5, lines 13-18, 43-45). An attenuation value represents the attenuation conditions experienced by signals on a particular transmission channel (i.e., at a particular antenna element). (Col. 5, lines 13-23, 54-61). Izumi's channel estimation means passes the attenuation values to a "signal adjustment means," which uses the values to calculate an amplitude adjustment factor for each transmission channel. (Col. 5, lines 43-45, 49-54). Izumi's signal adjustment means then multiplies each subcarrier signal by its corresponding amplitude adjustment factor to individually adjust the subcarrier signals according to the attenuations conditions of their corresponding transmission channel. (Col. 5, lines 54-61).

The Examiner states that col. 4, lines 45-54 of Izumi discloses receiving a preamble across a channel, the preamble including a training sequence. Applicant respectfully disagrees. Applicant acknowledges that Izumi's device receives OFDM signals that include preambles. However, Izumi does not show preambles that include a training sequence. A preamble is a set of symbols sent by a transmitter to a receiver at the front end of a data transmission which represent information about the following data packets. (Specification at page 3, para. [0008]). One method of establishing frequency synchronization and channel estimation for an OFDM system involves including a training sequence, a particular sequence of known transmit data, within the preamble. (Specification at page 7, para. [0023]; page 9, para. [0030]). To "train" a receiver using a training sequence, a transmitter sends two preambles, each containing an identical training sequence, across a channel. (Specification at page 9, para. [00301]). The receiver performs various operations on the training sequences to compute the correlation between the sequences, and thereby obtain the relevant timing and frequency information for the OFDM system. (See, e.g., Specification at page 9, para. [0030]; page 11, para. [0037]-page 12, para. [0040]). When training symbols are not included in a preamble, alternative methods – interpolation, for example – must be used to obtain channel estimates. (See, e.g., Specification at page 13, para. [0041]).

Izumi's device does not receive a preamble including a training sequence. Izumi's device does not use training sequences to perform channel estimation; instead, Izumi determines the *magnitude* of each preamble that it receives and compares this magnitude to the magnitude of

a “reference” preamble stored at the receiver. (Col. 3, lines 3-5; col. 5, lines 13-27; Fig. 2). Izumi’s device uses interpolation or filtering – not training sequences – to perform channel estimation for any subcarriers for which it does not calculate amplitude ratios. (Col. 5, lines 40-43). Nowhere does Izumi teach or suggest that the received preambles include a training sequence – indeed, training sequences are never even mentioned within Izumi’s specification. Applicant respectfully submits that claim 1 is allowable for at least these reasons.

Applicant respectfully submits that claim 1 is allowable as originally presented. However, for purposes of expediting prosecution and without concession, Applicant has amended claim 1 to recite receiving a preamble across a channel, the preamble including two or more training sequences. Neither Izumi nor Chuang teach or suggest this limitation. Applicant respectfully submits that the Examiner’s rejections are moot in view of this amendment and respectfully requests withdrawal of the rejection of claim 1 for these additional reasons. Applicant reserves the right to further argue the base claim limitations.

The Examiner acknowledges that Izumi fails to disclose Applicant’s claimed step of updating a channel estimate using the demodulated and decoded data symbols. The Examiner suggests that Chuang shows this step, and that it would have been obvious to apply Chuang’s teachings Izumi’s device in order to “improve channel quality such as minimize error rate of received data symbol.” Applicant respectfully disagrees, and submits that the Examiner has failed to establish a *prima facie* case of obviousness. The Examiner’s stated rationale for the combination of Chuang and Izumi is to improve channel quality though, *e.g.*, minimizing the error seen by received data. However, Izumi already discloses a way to minimize data error. As discussed above, Izumi’s channel estimation means compares the magnitudes of received and reference preambles and calculates channel-specific amplitude adjustment factors to account for such data error. (Col. 5, lines 43-45, 49-61). In fact, Izumi presents this method of amplitude adjustment as a particularly inventive aspect of its device. (Col. 2, lines 38-42). Adding Chuang’s channel estimation techniques on top of Izumi’s existing estimation techniques would be duplicative and superfluous; the Examiner’s only support for this combination is a design feature that Izumi already contains, and the Examiner has failed to posit any alternative

supporting rationale. Applicant respectfully requests withdrawal of the rejection of claim 1 for these additional reasons.

Claims 2-24 and 97-98 depend from claim 1, and are allowable for at least the reasons given above with respect to claim 1.

Claim 2 is also separately allowable for at least the following additional reasons. Claim 2 recites that updating the channel estimate includes performing operations on the demodulated and decoded data symbols, the operations excluding multiplication operations. The Examiner suggests that Izumi meets this limitation, pointing to the demodulator and decoder included in Izumi's OFDM signal processing chain. (Col. 4, lines 51-56). However, Izumi expressly states that the operations performed on the OFDM signals *include* multiplication operations. Izumi's communication device includes a "signal adjustment means" which calculates amplitude adjustment factors to be applied to the subcarrier signals within an OFDM signal. (Col. 5, lines 43-45, 49-54). The amplitude adjustment factors are weighted coefficients that each OFDM subcarrier signal is multiplied by. (Col. 5, lines 52-58; col. 6, lines 45-49; col. 7, lines 5-23). Indeed, Izumi even refers to the point of application within the signal processing chain as the "*multiplication point*." (Col. 5, lines 54-58) (emphasis added). Izumi fails to teach or suggest performing operations excluding multiplication operations, and Applicant respectfully submits that claim 2 is separately allowable for at least these additional reasons.

Claims 5-6, 9-16, and 23 are also separately allowable for at least the following additional reasons. The Examiner provided a blanket rejection for these claims, stating only that the claims were "rejected due to their dependency to parent claims." However, a *prima facie* case of obviousness requires the Examiner to show that the prior art teaches or suggests each and every claim limitation. See, e.g., *In re Royka*, 490 F.2d 981 (C.C.P.A. 1974). Dependent claims necessarily add limitations to the claims from which they depend and, therefore, may not be subject to the same asserted grounds of invalidity. *Dana Corp. v. American Axle & Manufacturing, Inc.*, 279 F.3d 1372, 1376 (Fed. Cir. 2002); see also *Apple Computer, Inc. v. Articulate Systems, Inc.*, 234 F.3d 14, 24 (Fed. Cir. 2000) (remanding for legal error where district court failed to consider the validity of each dependent claim individually). Here, for

example, dependent claim 5 recites the limitation of averaging the two or more training sequences of the preamble. The Examiner has failed to point to anything in Izumi or Cheung that discloses this limitation. Similarly, the Examiner has failed to point to anything in Izumi or Chuang showing that the preamble comprises a pre-determined number of excited subcarriers and non-excited subcarriers, as recited by claim 9. As the Examiner has failed to identify any basis independently supporting the rejection of claims 5-6, 9-16, and 23, Applicant respectfully submits that the Examiner has failed to sustain his burden of establishing a *prima facie* case of obviousness.

B. Claim 25 and its dependent claims

Claim 25 as amended is directed to a communication device including a receiver, a Fourier transform module that performs a Fourier transform of two or more training sequences received in a preamble in a frequency domain, and a channel estimator that derives initial channel estimates in the frequency domain using the received preamble and a stored preamble. The communication devices further includes a decoder to demodulate and decode received data symbols and an update module that updates the channel estimate using the demodulated and decoded data symbols.

Neither Izumi nor Chuang teach or suggest, at least, Applicant's claimed Fourier transform module that performs a Fourier transform of two or more training sequences received in a preamble in a frequency domain. Additionally, as discussed above, the Examiner has failed to establish a proper motivation to combine Izumi and Chuang. Therefore, Applicant respectfully submits that claim 25 is allowable for at least the reasons given above with respect to claim 1.

Claims 26-48 and 99-100 depend from claim 25, and are allowable for at least the reasons given above with respect to claim 25.

Claim 26 is also separately allowable for at least the additional reasons given above with respect to claim 2.

The Examiner has failed to identify any basis independently supporting the rejection of claims 27-30 and 33-40. Therefore, claims 27-30 and 33-40 are also separately allowable for at least the additional reasons given above with respect to claims 5-6, 9-16, and 23.

Additionally, although claims 44 and 47 are listed as being rejected, the Examiner has entirely failed to address these claims in his rejections. Applicant respectfully submits that claims 44 and 47 are allowable for at least these reasons.

C. Claim 49 and its dependent claims

Claim 49 as amended is directed to a communication device including means for receiving preambles and data symbols, means for performing a Fourier transform of two or more training sequences received in a preamble, and means for deriving initial channel estimates in the frequency domain using the received preamble and a stored preamble. The communication device further includes means for demodulating and decoding received data symbols and means for updating the channel estimate using the demodulated and decoded data symbols.

Neither Izumi nor Chuang teach or suggest, at least, Applicant's claimed means for performing a Fourier transform of two or more training sequences received in a preamble. Additionally, as discussed above, the Examiner has failed to establish a proper motivation to combine Izumi and Chuang. Therefore, Applicant respectfully submits that claim 49 is allowable for at least the reasons given above with respect to claim 1.

Claims 50-72 and 101-102 depend from claim 49, and are allowable for at least the reasons given above with respect to claim 49.

Claim 50 is also separately allowable for at least the additional reasons given above with respect to claim 2.

The Examiner has failed to identify any basis independently supporting the rejection of claims 51-72. Therefore, claims 51-72 are also separately allowable for at least the additional reasons given above with respect to claims 5-6, 9-16, and 23.

D. Claim 73 and its dependent claims

Claim 73 as amended is directed to a computer program product that causes data processing apparatus to perform the steps of performing a Fourier transform of two or more

training sequences received in a preamble across a channel, deriving initial channel estimates in the frequency domain with the received preamble and a stored preamble, demodulating and decoding the data symbols received across the channel, and updating the channel estimate using the demodulated and decoded data symbols.

Neither Izumi nor Chuang teach or suggest, at least, Applicant's claimed step of performing a Fourier transform of two or more training sequences received in a preamble across a channel. Additionally, as discussed above, the Examiner has failed to establish a proper motivation to combine Izumi and Chuang. Therefore, Applicant respectfully submits that claim 73 is allowable for at least the reasons given above with respect to claim 1.

Claims 74-97 and 103-104 depend from claim 73, and are allowable for at least the reasons given above with respect to claim 73.

Claim 74 is also separately allowable for at least the additional reasons given above with respect to claim 2.

The Examiner has failed to identify any basis independently supporting the rejection of claims 75-78 and 81-89. Therefore, claims 75-78 and 81-89 are also separately allowable for at least the additional reasons given above with respect to claims 5-6, 9-16, and 23.

B. The Examiner rejected claims 19-22, 24, 43, 45, 46, 48, 91, 93, 95, and 97, stating that although "Izumi does not disclose exponential update, least mean square update, Kalman update, hard decision update," one skilled in the art would have found it obvious to use one of the claimed updates to update demodulated and decoded symbols.

As discussed above, the Examiner's asserted combination of Izumi and Chuang fails to teach or suggest each and every limitation recited by Applicant's independent claims 1, 25, 49, and 73, as amended. Applicant respectfully submits that claims 19-22, 24, 43, 45, 46, 48, 91, 93, 95, and 97, each of which depends from one of claims 1, 25, 49, and 73, are allowable for at least these reasons.

Additionally, Applicant respectfully submits that the Examiner has not provided any evidence to support the contention that *each* of Applicant's claimed limitations that recite using Kalman adaptive filtering, making a hard decision of which constellation point is closest to a

received subcarrier, using Least Mean Square adaptive filtering, and using an exponential update adaptive filtering to update the channel estimates were well-known in the art at the relevant time. Applicant respectfully submits that assertions of technical facts or specific knowledge within the prior art must always be supported by citation to a reference that is recognized as standard in the pertinent art. *See, e.g., In re Zurko*, 258 F.3d 1379, 1386 (Fed. Cir. 2001) (without “concrete evidence in the record,” the Board’s assessment of what was “basic knowledge” to one of ordinary skill in the art did not support an obviousness rejection). Applicant respectfully submits that claims 19-22, 24, 43, 45, 46, 48, 91, 93, 95, and 97 are allowable for at least these additional reasons.

C. The Examiner rejected claims 98-105, stating that although Izumi fails to disclose channel estimation compliant with IEEE 802.11a and 802.16a, “performing OFDM channel estimation in IEEE 802.11, 802.16a standard has been well-known in the art and the OFDM technology has been standardized in IEEE 802.11a in the US.”

As discussed above, the Examiner’s asserted combination of Izumi and Chuang fails to teach or suggest each and every limitation recited by Applicant’s independent claims 1, 25, 49, and 73. Applicant respectfully submits that claims 19-22, 24, 43, 45, 46, 48, 91, 93, 95, and 97, each of which depends from one of claims 1, 25, 49, and 73, are allowable for at least these reasons.

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No fees are believed to be due at this time. Please apply any other charges or credits to deposit account 06-1050.

Respectfully submitted,

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